NEWS

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NEW X-RAY STAR

A new pulsating X-ray star quite unlike the one other known X-ray pulsar has been detected in our Milky Way galaxy by the National Aeronautics and Space Administration's Explorer 42, the Small Astronomy Satellite, launched last Dec. 12.

The newly-detected X-ray pulsar, 13 new X-ray objects found both within the Milky Way and several remote galaxies, and confirmation that a distant quasar is a source of powerful X-rays, are included in the initial scientific results from Explorer 42. They were discussed today at the American Astronomical Society in Baton Rouge, LA, by Dr. Riccardo Giaconni from the American Science and Engineering (AS&E), Cambridge, MA, principal investigator for the satellite.

The new X-ray pulsar, identified as Cygnus X-1 in the Constellation Cygnus, was observed by the satellite to generate precisely-timed X-ray pulses at the rate of about 15 per second.

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Both NASA and AS&E astronomers were surprised at this discovery although Cygnus X-1 has been known to be a variable X-ray source for a number of years.

The current explanation for an object in space emitting well-timed energy pulses is that of a rotating neutron star, since a high rate of rotation means that the spinning star must be a collapsed object.

Although Cygnus X-1 is an X-ray pulsar like NP-0532 in the Crab Nebula, there are many dissimilarities including its origin which is apparently quite different.

In theory, the Crab Nebula and its X-ray pulsar were created when a highly evolved star exploded in the Milky Way about one thousand years ago. The pulsar was produced when gravitational collapse caused infalling material to be compacted to a nuclear density of about a billion tons per-cubic-inch in one second. A rebounding shock wave drove off the outermost layers of the star's atmosphere to produce an expanding cloud of gas. It is this gas cloud that is so visible in the night sky as the Crab Nebula.

If Cygnus X-1 were the result of a supernova explosion like the one that created the Crab Nebula and NP-0532, there should be a detectable remnant surrounding Cygnus X-1. There is none, and Cygnus X-1's estimated age of 10,000 years is too short a time for a supernova remnant to have evolved and disappeared.

This leads the experimenters to conclude that Cygnus X-1 was not formed in a supernova explosion or that, for some reason, its remnants are not detectable in either the visible or radio energy range as supernova remnants.

Other than a neutron star, Cygnus X-1 could prove to be a theoretical "black hole." Although little is known how such an object is formed, it is considered to be so dense that its gravitational field prevents matter and energy from escaping. It is speculated that X-rays may be produced in great quantities by material surrounding this object.

Results of the first complete scan of the Milky Way are also included in the initial results from Explorer 42. Of the 33 X-ray objects observed in this galaxy, ten have never been seen before. This data clearly shows what is known to be a general distribution of X-ray sources in our galaxy. Specifically, this includes a strong concentration of discrete sources near the galaxy's center and single isolated sources at other points around the Milky Way.

The actual observing time to complete this first Milky Way scan was less than three hours. This is only a small fraction of the total time that will be ultimately available. Thus, it is expected that many new sources will be detected in our galaxy.

Until the Small Astronomy Satellite was launched, the only object outside the Milky Way definitely known to emit X-rays was the galaxy M87, located in the Virgo cluster of about 1,000 galaxies. There was also evidence that X-rays were emitted from the quasar 3C273 and the source NGC 5128 located in the constellation Centaurus.

Data from the satellite confirms that these sources do emit vast amounts of X-rays, and further discovered X-ray emissions from three new objects. These new sources include the distant galaxy M84 also in the Virgo cluster, and the nearby Seyfert galaxies NGC-4151 and NGC-1275. NGC-1275 was reported earlier by researchers from the Naval Research Laboratory to be a possible X-ray source.

The Seyfert galaxies, not previously known to be X-ray emitters, are a distinct class of galaxies characterized by an extremely bright and active nuclear region quite different from our galaxy. In many ways, these galaxies resemble the quasar which is neither star nor galaxy, but nonetheless, a powerful radio source. Quasar means quasi-stellar radio source.

Detection of X-rays from the Seyfert galaxies, along with the satellite's confirmation that the quasar 3C273 is an X-ray emitter, could prove to be major clues to understanding the possible evolution of quasars to Seyfert galaxies and then to more quiet galaxies like the Milky Way.

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The quasar 3C273 is the most distant object from us known to emit X-rays. This quasar is a billion light years away. A light year is the distance light travels in one year at the speed of 186,000 miles-a-second. Because of its distance, the X-ray source in this quasar must be extraordinarily powerful.

Explorer 42 data reveals that the galaxy M87 source is not as simple as it was conceived to be. Rather than originating from a point in the galaxy, X-rays from this area seem to be coming from an area much larger than that occupied by the M87 galaxy.

One possible explanation for this result is that M84, which is a nearby neighbor of M87, contributes as much as one half of the total X-ray emission observed from this part of the sky.

High energy astronomy, of which the study of X-rays is a vital part, has revised many basic astronomical concepts since discovery of the first stellar X-ray source in 1962. These objects radiate much more energy in X-rays than any other form of radiation as opposed to common stars in which only about one-millionth of their emitted energy is in the form of X-rays.

The project scientist for Explorer 42, Dr. Carl Fichtel of NASA's Goddard Space Flight Center, Greenbelt, MD, said, "Explorer 42 represents a giant step forward in astronomy by providing the first complete and sensitive picture of the sky in X-rays. These first results from the satellite confirm the expectation that not only significant, but some unexpected phenomena would be discovered, relating directly to the fundamental high energy processes which govern the evolution of stars and galaxies."

The first Small Astronomy Satellite was launched for the United States by Italy from a mobile launch platform off the coast of Kenya last Dec. 12 into a circular equatorial orbit. It was also named Uhuru, Swahili for freedom.

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